Manzanola

Lagoon

First wetland cell

Wetland cells #1 and #2

Influent pipe to cell #1

Manzanola Facility Statistics	
Nearest Town:	**Manzanola**
County:	**Otero**
River Basin:	**Lower Arkansas**
Receiving Water Body:	**Unnamed irrigation ditch, less than 1 mile from Arkansas River**
Year Online:	**1998**
Population:	**450**
Elevation (feet):	**4230**
Design Flow (mgd):	**0.125**
Average Flow (mgd):	**0.045**
Size (acres):	**2.3**

Facility Description

The Manzanola wastewater treatment facility is a domestic minor municipal lagoon system. The facility consists of one aerated lagoon, a settling pond, constructed wetlands followed by chlorine disinfection.

Lagoons

The Manzanola lagoon system consists of 2 cells, separated by two floating curtains. Some features of this lagoon system are detailed in the table below.

Lagoon Information		
Cell No.:	**1**	**2**
Surface Area (sq. ft.)	**51,500**	**12,200**
Avg. Depth (ft)	**5**	**5**
Avg. Volume (Million gallons)	**1.559**	**0.339**
Detention time (days)	**12.5 - 36**	**2.7 – 7.6**
Aerator size (hp)	**12**	**NA**

Background Information

The Town of Manzanola has operated its wastewater treatment facility since the 1930's. The original system consisted of a two-cell stabilization lagoon. Actual effluent discharge data was not reported by the Town until September of 1994. The Town's inability to meet permit regulations resulted in a notice of significant non-compliance for exceeding BOD5 and fecal coliform limitations in March 1995 the Town of Manzanola received. This noncompliance continued resulting in the issuance of a Notice of Violation and Cease and Desist Order in July 1995. An engineering evaluation concluded that a new mechanical facility would require both substantial initial capital cost and heightened ongoing annual operation and maintenance costs. They also require a higher level of operator certification. Small communities like Manzanola are best served by adhering to a simpler form of treatment if only secondary treatment levels are required. The recommended improvements converted the original two-cell facultative lagoon into an aerated cell, a facultative cell, followed by a surface flow constructed wetland.

Energy Analysis

The lagoon aerators and the chlorine injection system are the primary energy consumers. The lagoon system uses 4 – 3hp aerators.

Wetland Design

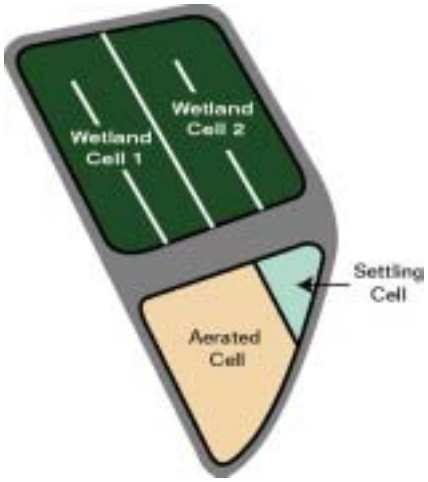
Design Methods

The design of the constructed wetland was based on a minimum hydraulic residence time of 6 days and a minimum aspect ratio of 8 to 1. A secondary consideration was BOD5 removal during the spring. A water

balance was done to determine the hydraulic loading rate of the constructed wetland system. The hydraulic loading rate was based on a volume per area basis. For the Manzanola system a maximum design HLR of 1.228 gpd/ft2 was selected. BOD reduction was modeled by first order, plug flow, reaction kinetics model developed by Reed, Middlebrooks and Crites. This is an iterative design method necessary to ensure that all minimum design requirements are met.

Objectives

The primary design concern is solids (algae) carry-over in the treatment facility effluent and the BOD5 load associated with these solids. Two of the most significant design parameters with regard to TSS control are hydraulic residence time (HRT) and aspect (length to width) ratio.



Size

The wetland system consists of two treatment cells, each with an area of 49,800 ft. The total area for the wetland system is 99,600ft2, or 2.3 acres.

Shape

The constructed wetland cells are rectangular with a serpentine flow pattern.

Hydraulics

Gravity conveyance is used throughout the system. Perforated pipes are used to introduce the wastewater into the wetland cells. Adjustable tees are used to vary the water depth in the wetland. A serpentine flow path provides prevents short-circuiting through the system.

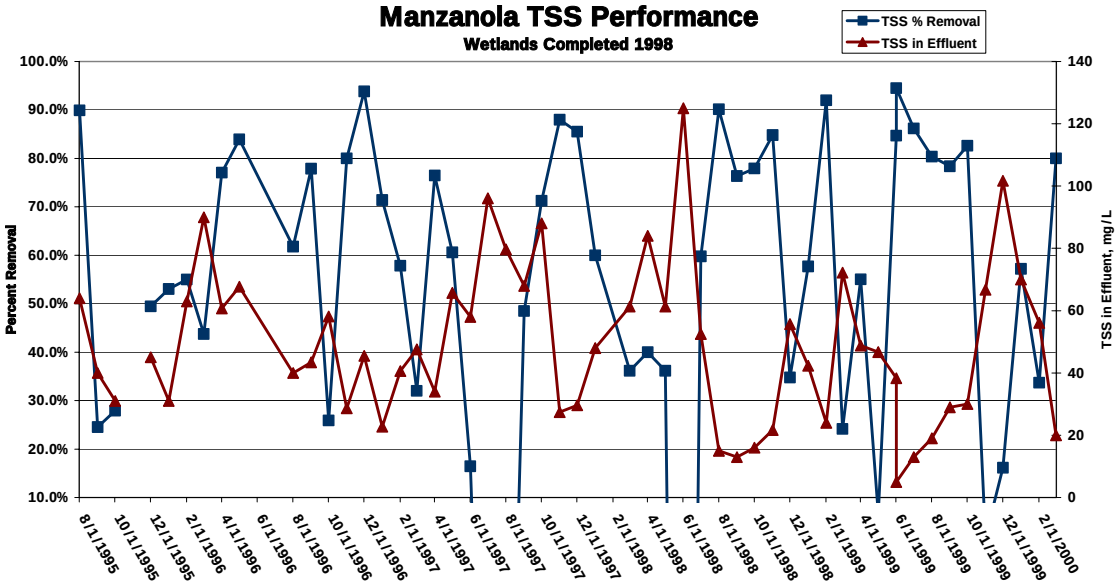
Treatment Goals

Permitted Discharge Limitations	
Oil and Grease:	**10 mg/l (Daily Max)**
BOD_5:	**30 mg/l (30-day ave)**
BOD_5 Removal:	**85%**
TSS:	**75 mg/l (30-day ave)**
PH, su (min – max)	**6.0 – 9.0 (Daily Max)**
Fecal Coliform Bacteria:	**6,000 organisms per 100 ml (Daily Max)**

Water Quality Data

TSS Data

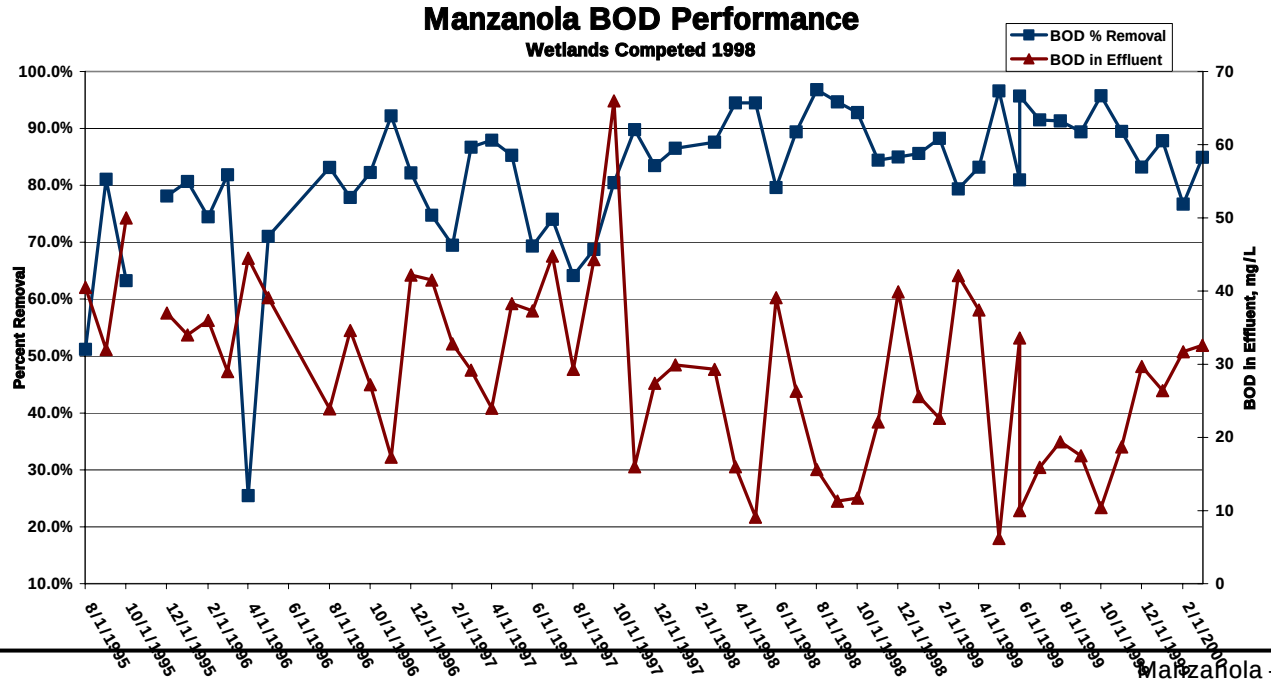
The TSS graph plots the percent removal on the left axis and TSS in mg/l in the effluent on the right axis.



The average monthly TSS in the influent, since the wetland implementation, has been 121 mg/l and the average monthly effluent has been 34 mg/l. This meets the permit discharge requirement of 75 mg/l.

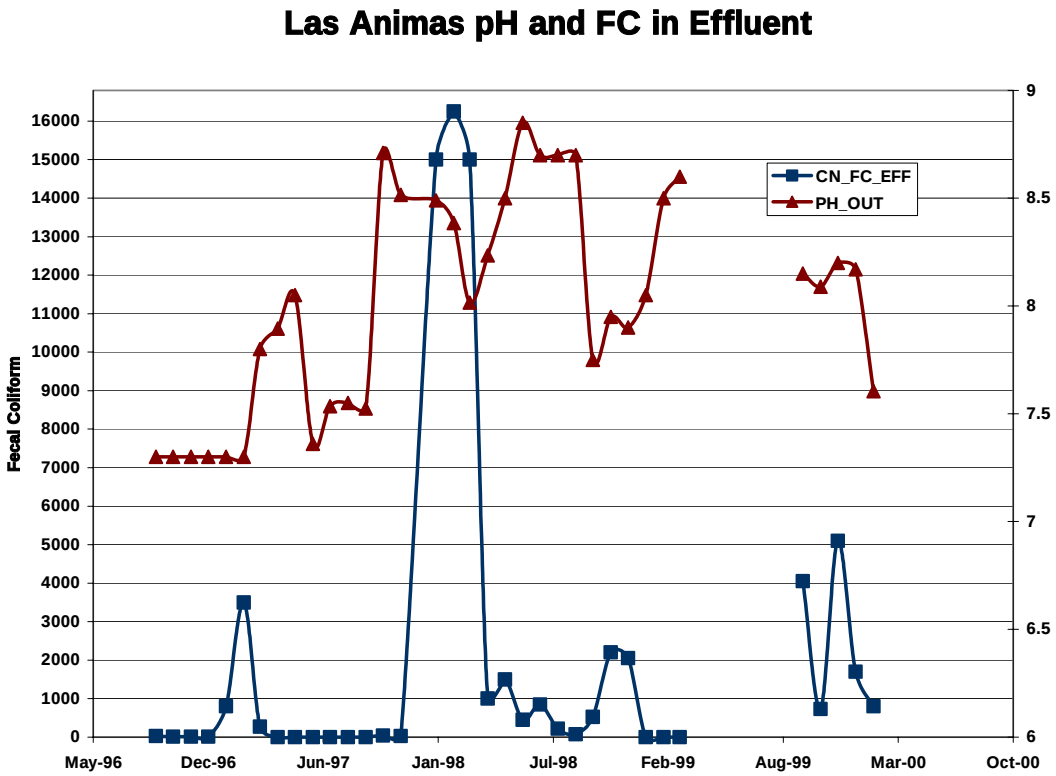
BOD Data

The BOD data is plotted similarly to the TSS data, with mg/l in the effluent on the right axis, and percent removal on the left axis. . The average monthly influent amount has been 211 mg/l and the average monthly effluent amount has been 23 mg/l.



pH and Fecal Coliform

Data for these two categories have been plotted on the same graph. Data reflect the quality of the effluent; no influent measurements are taken for these parameters. The pH values plotted are an average of the minimum and maximum 30-day values that are reported in the monthly reports. Previous to the wetland implementation, data indicate that average pH values in the effluent were close, and sometimes exceeded,



the maximum daily allowable of value 9. Since the wetland implementation, pH values have consistently stayed within the allowable range of 6.5 to 9.

General Ecological Setting

The Manzanola constructed wetland is located along a ditch that empties into the Arkansas River. The cells are flat, rectangular, and are 99 percent vegetated and 1 percent open water. The wetland is located on the north side of Manzanola, on the Arkansas River terrace. The design of this treatment wetland is identical to the Town of Crowley treatment wetland.

Cell Vegetation

The Manzanola site consists of two identical cells, which total 2.3 acres. The two cells have similar plant communities dominated by cattail (*Typha latifolia*) and duckweed (*Lemna minor*); however, the west cell (cell 1) has significant algal growth, and the vegetation is almost entirely dead. No water is currently flowing into or out of the wetland. Vegetation covers 45 percent of the wetland, open water covers 45 percent, and litter accounts for the remaining 10 percent cover. The soil surface is inundated from 0 to 1

foot. The east cell (cell 2) is 80 percent covered by vegetation, 10 percent open water, and 10 percent litter. This cell also has narrow leaved cattail (*Typha angustifolia*), and has no significant amount of algal growth. Die-off is not as significant as in the western cell.

Planting/Seeding

The site was planted to encourage vegetation establishment; however, no records document the species and amounts planted.

Weeds

No noxious weeds were noted.

Maintenance Issues

The cause of vegetation die-off should be identified and mitigated.

Wildlife

The Manzanola wetland provides habitat for muskrat, waterfowl, songbirds, and red winged black birds. During the site visit, waterfowl, songbirds, and red winged black birds were observed. Muskrat have caused problems for site maintenance, and are being eliminated. When the cattail stands are in good health, this wetland probably has some vegetative structural diversity because of the presence of the shallow water pockets. The presence of shallow water and emergent vegetation provides habitat for waterfowl, songbirds, and muskrats.

Wetland Biodiversity Functional Assessment

Sediment/nutrient/toxicant removal rated high, and production export/food chain support rated moderate. General wildlife habitat rated moderate because of the presence of open water and potential habitat; however, extensive open water is present because a significant number of cattail have died. Habitat diversity and uniqueness of the constructed wetland rated low.

Wetland Biodiversity Functional Assessment.

Function and Value Variables	Functional Points (0.1 to 1)	Possible Points
General Wildlife Habitat	0.5 (mod.)	1
General Fish/Aquatic Habitat	0.0	1
Production Export/Food Chain Support	0.7 (mod.)	1
Habitat Diversity	0.2 (low)	1
Uniqueness	0.2 (low)	1
Total Points	2.8 (56%)	5
Wetland Category (I, II, III, or IV)	III	

Human Use

The wastewater wetland is part of a restricted public access area, and has never been used for educational purposes. This wetland has low aesthetic value because it is dominated by areas of bare gravel and weedy species.

Overall Site Comments

A large portion of the site has not developed wetland vegetation. The sewage lagoons at the site provide open water habitat for wildlife, but the treatment wetland provides only limited habitat. This site has consistently had trouble meeting discharge permit limitations.